

REMARKS

Claims 1-13 and 15-21 were pending. Claims 16 and 19 have been canceled.

Claims 1, 2, 8, 9, 15, and 18 have been amended. Reexamination and reconsideration of the present application is respectfully requestd.

At the outset, the Examiner is thanked for the thorough review and consideration of the present application. The Examiner's Office Action dated December 12, 2003 has been received and the contents carefully noted.

The Examiner rejected claims 1-3, 6, 15, and 17 under 35 USC 103(a) as being unpatentable over Pfeil (US Patent No. 2,406,966) in view of Gotou et al. (US Patent No. 6,078,129). This rejection is respectfully traversed.

Claim 1, as amended, is allowable at least for the reason that claim 1 recites a combination of features, including, for example, a ground electrode being connected to a metal shell through a laser fused weld. This novel embodiment is discussed for example on page 10, line 22 to page 11, line 5, where a joint of a ground electrode 40 and a metal shell 10 provided by laser welding is formed by a series of fused portions 45. As clearly shown in FIG. 2(b), materials of the ground electrode 40 and the metal shell 10 are melted together by a sequence of laser radiations, while the joint provided by the arc welding is formed by a single fused portion 45. The laser fused weld as shown in Figures 2(a)-2(c) is different than one formed from arc welding as shown in Figures. 3(a)-3(c).

Pfeil discloses a spark plug having a center electrode with two portions 1 and 5 and a ground electrode 8 spot-welded at 9 to a plug nose 10. *See* column 3, lines 54-68. A piece of silver or copper wire is dropped into a hole in the insulator 3 and the whole assembly is passed through a furnace to melt the silver or copper wire and cause it to fuse around the

wire 1 as shown at 4 and subsequently to solidify in position. *See* column 3, lines 1-45.

The Examiner states that one of ordinary skill in the art would have used a commonly known arc welding technique to weld the ground electrode to the metal shell in the reference.

However, Pfeil fails to teach or suggest the features recited in claim 1, namely, a ground electrode that is connected to a metal shell by laser fused weld, to achieve the novel and nonobvious features of the present invention.

The Examiner cites Gotou et al. in an attempt to cure the deficiencies of Pfeil. Gotou et al. teaches a spark plug including a center electrode 2 to which a noble metal chip 1 is attached via laser welding. A ground electrode 3 is attached to housing 91; however, there is no discussion of the method used for attachment. *See* column 3, lines 24-39. Thus, Gotou et al. fails to cure the deficiencies of Pfeil. Further, neither of the cited references teaches a ground electrode connected to the metal shell through a laser fused weld as recited in claim 1.

Laser welding does not involve a pressing operation as required in the resistance welding, thus allowing the spark gap 50 to be adjusted easily during welding using a spacer without applying an unwanted load on the Ir alloy and its weld. This eliminates the need for a gap adjustment process after the welding which is essential to the conventional spark plugs. *See* specification at page 16, line 12.

Therefore, the use of spot-welding techniques (resistance welding) taught in Pfeil result in shrinkage of the ground electrode at the weld, thus requiring a gap adjustment. Even *assuming arguendo* that the two types of spot-welding techniques discussed by the Examiner on page 2 of the Office Action are also arc welding, laser welding is different from arc welding. *See* Figures 2(a)-2(c), 3(a)-3(c), and page 11, lines 6-22 of the

specification of this application. The graph of FIG. 5 also shows that the laser-welded samples, as indicated by the black circles, are kept in the joint strength higher than the arc-welded samples, as indicated by the white circles. It is, thus, advisable that the ground electrode 40 be connected to the metal shell 10 by means of the laser welding. See page 16, lines 3-7.

It can thus be understood that the combination of references does not in any way make obvious the essential features of the present invention as set out in independent claim 1. Applicant respectfully requests that the rejection of claims 1-3, 6, 15, and 17 under 35 USC 103(a) be withdrawn.

Moreover, as claims 2, 3, 6, 15, and 17 each depend from independent claim 1, each of these claims is also allowable for the same reasons as their respective base claim.

The Examiner rejected claims 4 and 5 under 35 USC 103(a) as being unpatentable over Pfeil in view of Gotou et al. as applied to claim 1 above, and further in view of Takafumi et al. (JP 63-266-46). This rejection is respectfully traversed.

Claims 4 and 5 recite features regarding the metal shell material. In tests conducted by Applicant, it was discovered that in order to ensure a desired reliability level of the joint of the ground electrode 40 to the Fe alloy metal shell 10, the contents of S, Si, C, Mn, and P should contain the claimed ranges discussed in the specification at pages 13-19.

As discussed above, the combination of Pfeil and Gotou et al. fails to teach or suggest the features of independent claim 1, upon which claims 4 and 5 depend. The Examiner cited Takafumi et al. in an attempt to cure the deficiencies of the other two references.

Takafumi et al. teaches a spark plug made having improved tensile strength and made of steel containing by weight, 0.03-0.20% C, 0.35% Si, 0.1-2.0% Mn, 0.025% P,

0.25% S and 0.005-0.080% Al, and furthermore containing a material selected from the group of 0.005-0.25% Zr, 0.005-0.10% Nb, 0.03-0.25% V, 0.005-0.25% Ti, 0.05-0.50% Cr and 0.05-0.50% Ni and with the balance consisting of Fe with inevitable impurities.

Takafumi et al. is merely concerned with the material used for the spark plug housing, but fails to discuss a Fe alloy metal shell having other contents as recited in claims 4 and 5. Furthermore, in Takafumi et al. the ground electrode is not connected to the metal shell by a weld fused by laser welding as recited in claim 1. Thus, Takafumi et al. fails to cure the deficiencies of the other two references.

It can thus be understood that the combination of references does not in any way make obvious the essential features of the present invention as set out in independent claim 1. As claims 4 and 5 depend from independent claim 1, each of these claims is also allowable for the same reasons as their respective base claim. Applicant respectfully requests that the rejection of claims 4 and 5 under 35 USC 103(a) be withdrawn.

The Examiner rejected claim 7 under 35 USC 103(a) as being unpatentable over Pfeil in view of Gotou et al. as applied to claim 1 above, and further in view of Franks (US Patent No. 3,958,144). This rejection is respectfully traversed.

Claim 7 recites features regarding the ground electrode material. The ground electrode may be made of an alloy containing a main component of 50 Wt % or more of Ir and an additive of at least one of Rh, Pt, Os, Ni, W, Pd, and Ru.

As discussed above, the combination of Pfeil and Gotou et al. fails to teach or suggest the features of independent claim 1, upon which claim 7 depends. The Examiner cited Franks in an attempt to cure the deficiencies of the other two references.

Franks teaches a spark plug having electrodes formed from alloys that produce a sparking operation such as those discussed in column 1, lines 44-65. Outer electrode 8 is

electrically connected to a conventional threaded mounting shank 12 for mounting the plug in a cylinder, and forms an electrical ground. See column 2, line 62 to column 3, line 12.

Franks is merely concerned with the material used for the electrodes, but fails to discuss a ground electrode connected to a metal shell by a weld fused by laser welding as recited in claim 1. Thus, Franks fails to cure the deficiencies of the other two references.

It can thus be understood that the combination of references does not in any way make obvious the essential features of the present invention as set out in independent claim 1. As claim 7 depends from independent claim 1, this claim is also allowable for the same reasons as its respective base claim. Applicant respectfully requests that the rejection of claim 7 under 35 USC 103(a) be withdrawn.

The Examiner rejected claim 16 under 35 USC 103(a) as being unpatentable over Pfeil in view of Gotou et al. as applied to claims 1 and 15 above, and further in view of Matsubara et al. (US Patent No. 6,095,144). This rejection is deemed moot in view of the cancellation of claim 16.

The Examiner rejected claims 8-10, 13, 18, 20, and 21 under 35 USC 103(a) as being unpatentable over Pfeil in view of Gotou et al. and further in view of Franks (US Patent No. 3,958,144). This rejection is respectfully traversed.

Claim 8, as amended, is allowable at least for the reason that claim 8 recites a combination of features, including, for example, a ground electrode being all made of an Ir alloy including a main component of 50 Wt% or more of Ir and connected directly to a metal shell. This novel embodiment is discussed for example on page 10, lines 22 to page 11, line 5, where a ground electrode 40 is made of an Ir alloy bar as a whole and connected directly to the end 12 of the metal shell 10 by laser or arc welding.

Pfeil and Gotou et al. have been discussed above in reference to claim 1. The combination of references also fails to teach or suggest the features recited in claim 8, namely, a ground electrode being all made of an Ir alloy including a main component of 50 Wt% or more of Ir and connected directly to a metal shell, to achieve the novel and nonobvious features of the present invention.

The Examiner cites Franks in an attempt to cure the deficiencies of the other two references. Franks teaches a spark plug having electrodes formed from alloys that produce a sparking operation such as those discussed in column 1, lines 44-65. Outer electrode 8 is electrically connected to a conventional threaded mounting shank 12 for mounting the plug in a cylinder, and forms an electrical ground. See column 2, line 62 to column 3, line 12.

Franks is merely concerned with the material used for the electrodes, but fails to discuss a ground electrode being all made of an Ir alloy including a main component of 50 Wt% or more of Ir and connected directly to a metal shell as recited in claim 8. Thus, Franks fails to cure the deficiencies of Pfeil and Gotou et al.

The whole of the ground electrode 40 is made of an Ir alloy, thus resulting in an improved wear resistance thereof. The weld of the ground electrode 40 to the metal shell 10, that is, the fused portion(s) 45 is, thus, located far from the end 41 of the ground electrode 40 subjected to the intense heat, thereby avoiding an undesirable rise in temperature of the fused portion(s) 45. See page 12, lines 9-23. Thus, the breakage of ground electrode of the present invention is avoided due to the strength of the material used.

It can thus be understood that the combination of references does not in any way make obvious the essential features of the present invention as set out in independent claim

8. Applicant respectfully requests that the rejection of claims 8-10, 13, 18, 20, and 21 under 35 USC 103(a) be withdrawn.

Moreover, as claims 9, 10, 13, 18, 20, and 21 each depend from independent claim 8, each of these claims is also allowable for the same reasons as their respective base claim.

The Examiner rejected claims 11 and 12 under 35 USC 103(a) as being unpatentable over Pfeil in view of Gotou et al. and further in view of Franks as applied to claim 8 above, and further in view of Takafumi et al. (JP 63-266046). This rejection is respectfully traversed.

Claims 11 and 12 recite features similar to claims 4 and 5 regarding the metal shell material. As discussed above, the combination of Pfeil, Gotou et al., and Franks fails to teach or suggest the features of independent claim 8, upon which claims 11 and 12 depend. The Examiner cited Takafumi et al. in an attempt to cure the deficiencies of Pfeil.

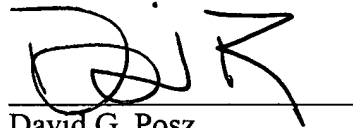
Takafumi et al. is merely concerned with the material used for the spark plug housing, but fails to discuss a Fe alloy metal shell having other contents as recited in claims 11 and 12. Furthermore, in Takafumi et al. the ground electrode is not all made of an Ir alloy including a main component of 50 Wt% or more of Ir and connected directly to a metal shell as recited in claim 8. Thus, Takafumi et al. fails to cure the deficiencies of the other references.

It can thus be understood that the combination of references does not in any way make obvious the essential features of the present invention as set out in independent claim 8. As claims 11 and 12 depend from independent claim 8, each of these claims is also allowable for the same reasons as their respective base claim. Applicant respectfully requests that the rejection of claims 11 and 12 under 35 USC 103(a) be withdrawn.

The Examiner rejected claim 19 under 35 USC 103(a) as being unpatentable over Pfeil in view of Gotou et al. and further in view of Franks as applied to claims 8 and 18 above, and further in view of Matsubara et al. (US Patent No. 6,095,124). This rejection is deemed moot in view of the cancellation of this claim.

In view of the above remarks, the present application is believed to be in condition for allowance. A prompt notice to that effect is respectfully requested. A one-month petition for extension of time and fee are included with this Amendment. Although no additional fees are believed to be due, permission is hereby given to charge any unforeseen fees to deposit account 50-1147.

Respectfully submitted,



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